

Camera power and video use same coax cable

FRANK COX, LINEAR TECHNOLOGY CORP, MILPITAS, CA

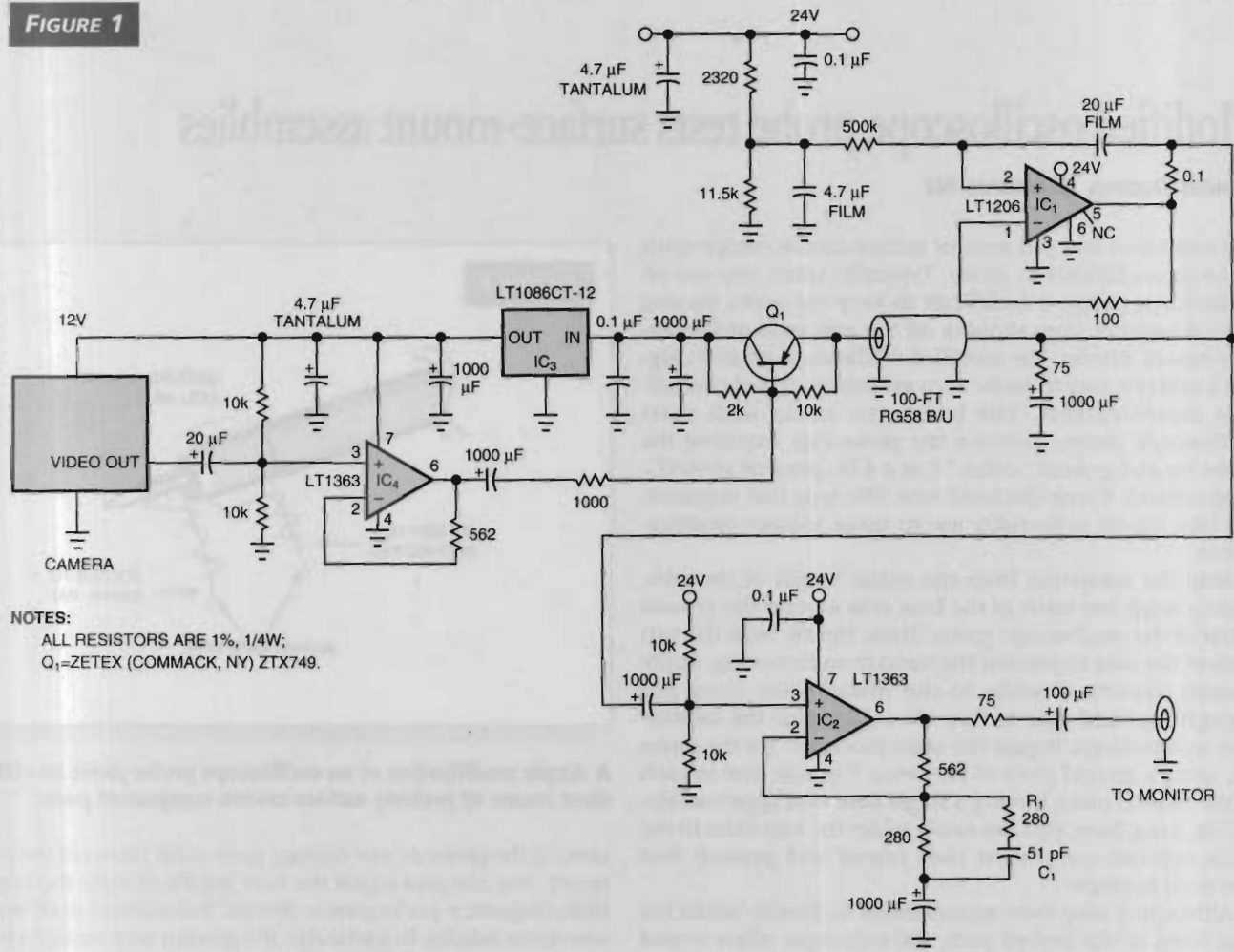
Because remotely located video-surveillance cameras do not always have a ready source of power, it is convenient to run both the power and the video signal through one coax cable. One way to accomplish this task is to use an inductor to present a high impedance to the video and a low impedance to dc. The problem with this method is that the frequency spectrum of a monochrome video signal extends down to at least 30 Hz. The composite-color video spectrum goes even lower, with components at 15 Hz. These figures entail a large inductor. For example, a 0.4H inductor has an impedance of only

75Ω at 30 Hz, which is approximately the minimum necessary impedance.

Large inductors have a large series resistance that wastes power. More important, large inductors have significant parasitic capacitance and stand a good chance of going into self-resonance below the 4-MHz video bandwidth, thus disrupting the signal. The circuit in Figure 1 takes a different approach to the problem by using all active components.

The circuitry at the monitor end of the coax cable supplies all the power to the system. IC₁, a power op amp, forms a

FIGURE 1



A synthesized inductor forms the heart of a technique to transmit both video signals and power over one coax cable.

gyrator, or synthetic inductor. The gyrator isolates the low-impedance power supply from the cable by maintaining a reasonably high impedance over the video bandwidth while contributing only 0.1Ω of series resistance. This op amp needs video bandwidth and enough output drive to supply 120 mA to the camera. The selected part has a guaranteed output current of 250 mA and a 3-dB bandwidth of 60 MHz, making it a good fit. Because the video needs capacitive coupling, no need exists for split supplies; the circuit thus uses one 24V supply. This supply also gives some head room for the voltage drop in long cable runs.

The camera end uses a 12V fixed-voltage regulator to supply 12V to a black-and-white CCD video camera. IC_4 supplies the drive for Q_1 , a fast, high-current transistor. Q_1 , in turn, modulates the video on the 20V-dc line. The collector of Q_1

is the input to the 12V regulator. This point is at ac ground, because it is well-bypassed by capacitors, as IC_3 requires. IC_1 is configured to deliver 20V to the cable. Because the 12V regulator at the camera end requires 1.5V dropout voltage, the series resistance of the cable can produce the 6.5V voltage-drop balance. The 20V output of IC_1 gives head room between the supply and the video. IC_2 , a video-speed op amp, receives video from the cable, supplies some frequency equalization, and drives the cable to the monitor. Equalization compensates for high-frequency roll-off in the camera cable. The values for R_1 and C_1 yield acceptable monochrome video with 100 ft of RG58 B/U cable. (DI #2087)

EDN

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Modified oscilloscope probe tests surface-mount assemblies

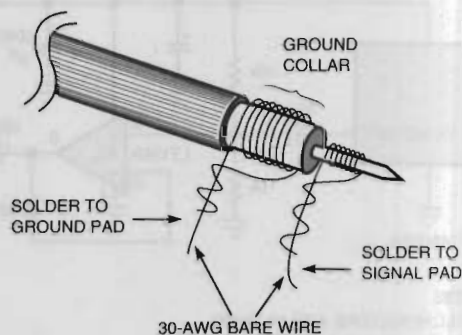
ROBERT BUONO, MAHWAH, NJ

The small sizes and pad areas of surface-mount components make them difficult to probe. Typically, when you use an oscilloscope probe, it is difficult to keep the probe tip and ground bayonet from slipping off the pad areas of the surface-mount devices. The modified oscilloscope probe in **Figure 1** makes it easy to probe such assemblies and obtain reliable measurements. The technique works with most oscilloscope probes. Remove the probe cap, exposing the probe tip and ground "collar." Cut a 4-in. piece of 30-AWG, single-strand, Kynar-insulated wire (the type that engineering labs almost universally use to make jumper modifications).

Strip the insulation from the entire length of the wire. Tightly wrap five turns of the bare wire around the ground collar of the oscilloscope probe. Then, tightly twist the two ends of the wire to prevent the turns from loosening. Apply a small amount of solder to the twisted wire, using just enough heat and time to flow the solder onto the twisted-wire terminations. Repeat the same procedure for the probe tip, using a second piece of bare wire. Cut one wire in each of the twisted pairs, leaving a single bare wire approximately 1-in. long. Now, you can easily solder the two wires to the surface-mount-component pads (signal and ground) that you need to probe.

Although it may seem inconvenient to directly solder the lead wires to the probed pads, the technique offers several advantages. Because the 30-AWG wire is thin, it does not require excessive heat or time to solder it to the pads. The potential for damage to surface-mount devices is thus minimal. Also, the wires are flexible, so small movements in posi-

FIGURE 1



A simple modification of an oscilloscope probe yields an efficient means of probing surface-mount-component pads.

tioning the probe do not damage pads or lift them off the pc board. You can also adjust the wire length to yield the best high-frequency performance (lowest inductance) and best waveform fidelity. In particular, the ground wire needs to be only long enough to reach the nearest ground pad. (DI #2085)

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Single chip builds tiny aircraft receiver

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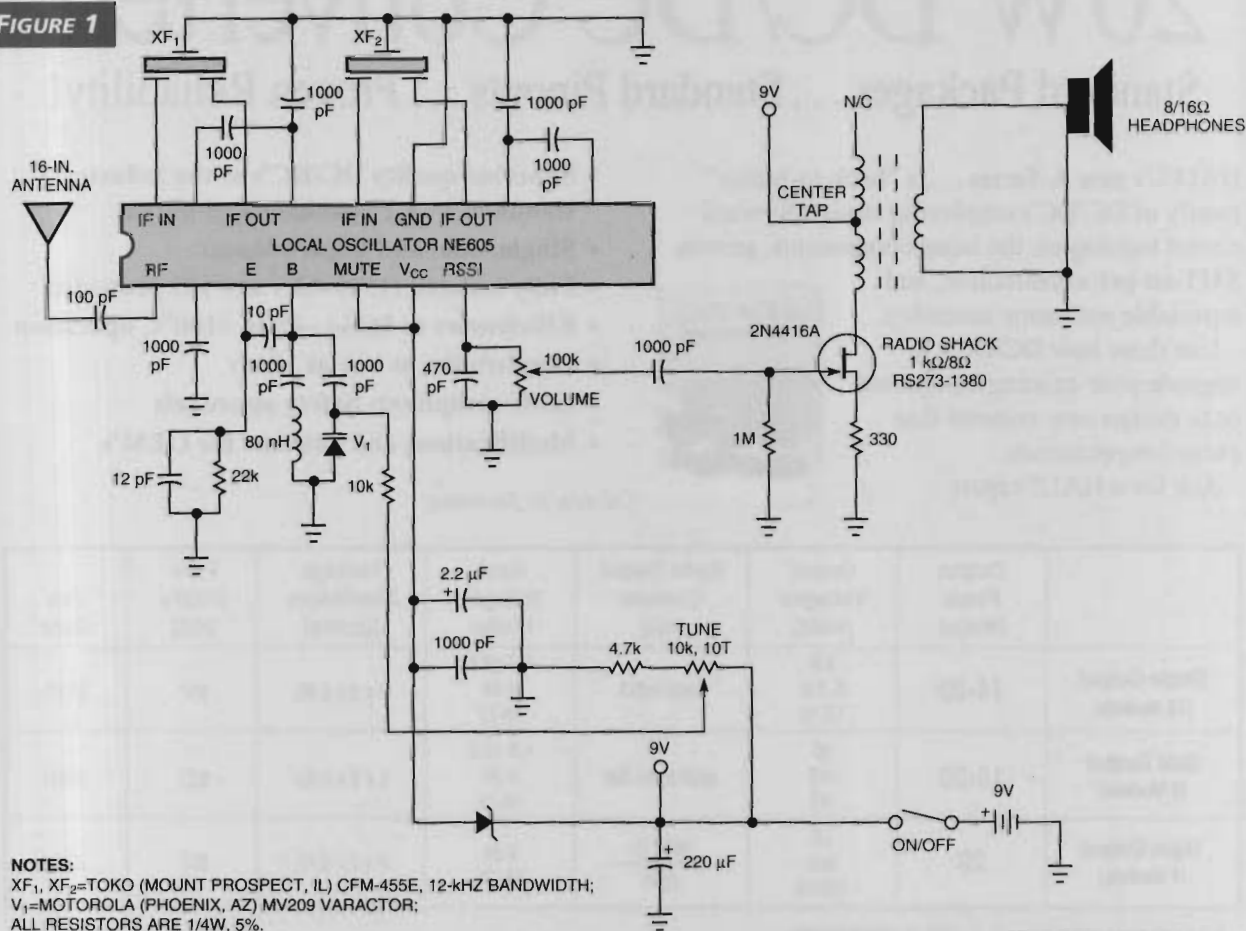
It's easy to become bored spending time in airports. After all, you can do only so much work on a notebook computer with no reference material around. So, relax and have some fun at the airport—build the tiny, single-chip, aircraft-band radio in **Figure 1** and listen to the planes come and go. The aircraft band extends from 108 to 135 MHz, and the communications are in AM mode. Using the single-chip NE605 (Philips Semiconductors, Sunnyvale, CA), you can build a radio that pulls in the control tower, ground communications, and, at larger airports, the TRACON (terminal-radar-approach-control) communications to aircraft flying overhead.

The NE605 is ideal for a simple AM receiver. It contains a mixer good to 500 MHz, an onboard local-oscillator (LO)

transistor, 80 dB of stable IF gain, and an FM-quadrature detector. This application does not use the FM detector; instead, the received signal-strength indicator (RSSI) serves to demodulate the AM signal's sidebands. The RSSI output is intended to provide an indication of the received signal's strength, but if an amplitude-modulated signal is tuned to the upper or lower sideband (slightly off center of the carrier), the RSSI acts like an AM demodulator.

In this circuit, the LO is based on a simple Colpitts-oscillator circuit. An MV209 varactor diode tunes the LO to the proper frequency. The LO feeds the internal mixer that directly gets its RF from a short antenna. The circuit uses no preselection at the input to the radio, because aircraft communications at all airports are sufficiently spread across the

FIGURE 1



Why twiddle your thumbs at airports when you can listen to the control-tower and airborne communications on this easy-to-build, single-chip receiver?

spectrum so that intermodulation arising from closely adjacent signals is usually not a problem. The intermodulation becomes even less of a problem thanks to the use of a small antenna. However, because of the lack of RF preselection, you hear each station at two spots on the radio tuning dial. You hear the signal when the LO is tuned 455 kHz below the RF signal and again when the LO is tuned 455 kHz above the desired channel's frequency.

The IF is 455 kHz, and the IF filtering comes from two low-cost ceramic filters. The filters are 12 kHz wide to make the tuning less sensitive (again, strong, adjacent channels are not usually a problem around an airport). The IF section consists of 80 dB of gain; each gain stage feeds a small current to the RSSI pin. When all these RSSI currents add up and the LO is tuned to one of the AM sidebands, the RSSI provides a

kind of AM demodulation. To get the output audio-signal level high enough to drive a small set of Walkman-type headphones (usually 8 or 16Ω), the circuit includes a simple audio amplifier. The amplifier consists of a 2N4416A- or an MPF-102-type n-channel JFET that drives a simple 1-kΩ to 8Ω audio transformer.

The battery drain is about 10 mA, so you can expect approximately 40 hours of operation from a standard 9V alkaline battery. You can use this basic circuit for FM communications on other VHF bands by using the built-in FM detector, or you can use it in AM mode from nearly dc to VHF by simply changing the LO frequency. (DI #2088) **EDN**

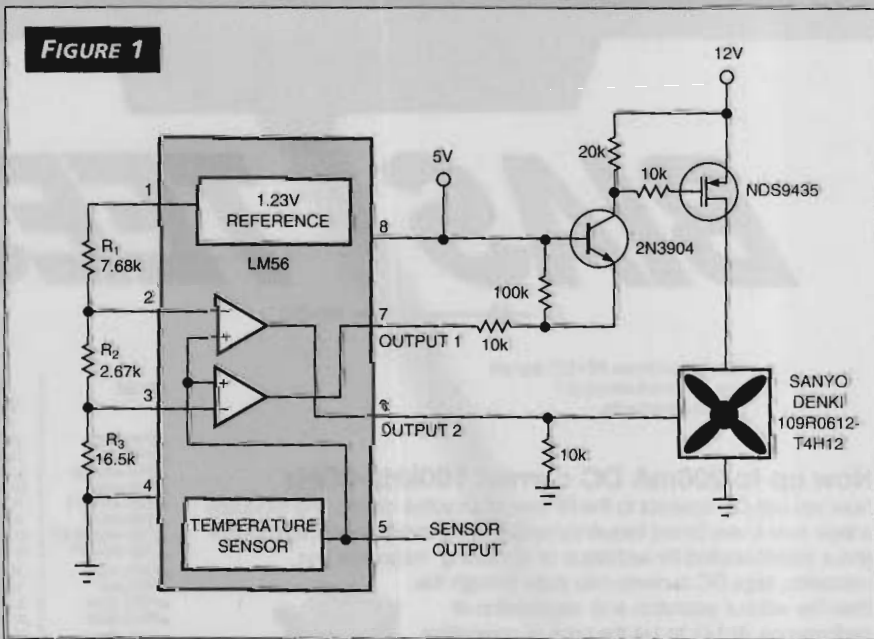
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Fan controller adapts to system temperature

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Any piece of electronic equipment—whether it be a lab instrument, an audio amplifier, or a PC—that relies on a cooling fan to control internal temperature is a potential source of noise pollution or even hearing damage. Most of the time, the fan's noise level is probably much higher than necessary, because it has enough capacity to move enough air to handle worst-case conditions. In many systems, the fan can either be off or running slowly most of the time with no damage to the system. Keeping the fan off or running slowly benefits you by reducing ambient noise and possible fatigue, irritated nerves, or even hearing damage. The circuit in Figure 1 adjusts a fan's speed according to temperature.

IC₁ is a temperature sensor with an internal voltage reference and two comparators. Three external resistors set input thresholds for comparison with the sensor's output voltage. When IC₁'s temperature rises above a comparator's input-threshold level, that comparator's open-collector output goes low. At low temperatures, output 1 is off, so the common-base npn transistor is also off. The gate of the p-channel MOSFET is high, keeping the cooling fan off. As temperature increases to above the first setpoint (60°C in this example), output 1 pulls down on Q₁'s emitter, turning on Q₁ and supplying power to the fan. The fan, which has a speed-control input, rotates



Cut nerve-racking, unnecessary fan noise by using this simple circuit to slow the fan or shut it off when you don't need it.

at low speed (1900 rpm in this example) when the speed-control input sees 10-kΩ impedance to ground.

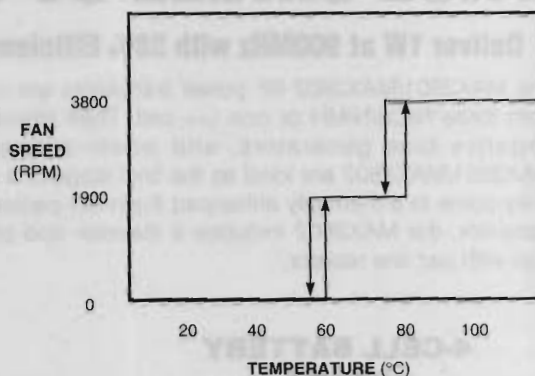
If temperature continues to increase to beyond the second setpoint (80°C with the values shown), IC₁'s comparator output 2 pulls the speed-control pin low, which causes the fan's speed to increase to its 3800-rpm maximum value. Set the temperature thresholds based on the sensor's output voltage

of $V_{TEMP} = 395 \text{ mV} + 6.2 \text{ mV}/^\circ\text{C}$ and the 1.25V reference. $R_1 + R_2 + R_3$ should be approximately 27 k Ω . The circuit in Figure 1 uses $\pm 1\%$ resistors; you can substitute $\pm 5\%$ resistors if you can tolerate setpoint errors on the order of 5°C . Figure 2 shows fan speed vs temperature. Note the 5°C hysteresis around each setpoint. This hysteresis is inherent in the LM56 to prevent the fan from "hunting" between two speeds when the temperature is near one of the setpoints. (DI #2086) **EDN**

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Approximately 5°C hysteresis at the two setpoints prevents the fan from switching between two speeds near the setpoint temperatures.

FIGURE 2



Pushbutton switch controls power supply and μC

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Switching handheld units on and off with a pushbutton switch is a desirable feature. Thus, switching-regulator/controller ICs for battery-powered applications provide a logic input to switch the device to a shutdown mode. This type of shutdown pin can require additional components and logic gates to implement the pushbutton interface. However, a simple circuit can implement an on/off function with no external logic (Figure 1). The circuit is based on IC₁'s step-down controller, which provides the toggle on/off function internally with a SET/RESET latch. Momentarily grounding the $\overline{\text{ON}}$ pin sets the latch and turns on the regulator; momentarily grounding the LBI/OFF pin resets the latch and turns off the regulator.

In Figure 1, with both the μC and the switching regulator powered down, pressing the pushbutton switch grounds IC₁'s $\overline{\text{ON}}$ pin and starts the regulator, which then powers up the μC . When you press the pushbutton switch a second time, the μC input detects the pressed switch's state. The μC then pulls the LBI/OFF pin low through a connection to one of its outputs. With the LBI/OFF pin low, IC₁ powers down, turning off the μC .

The diode between IC₁'s $\overline{\text{ON}}$ pin and the μC is necessary

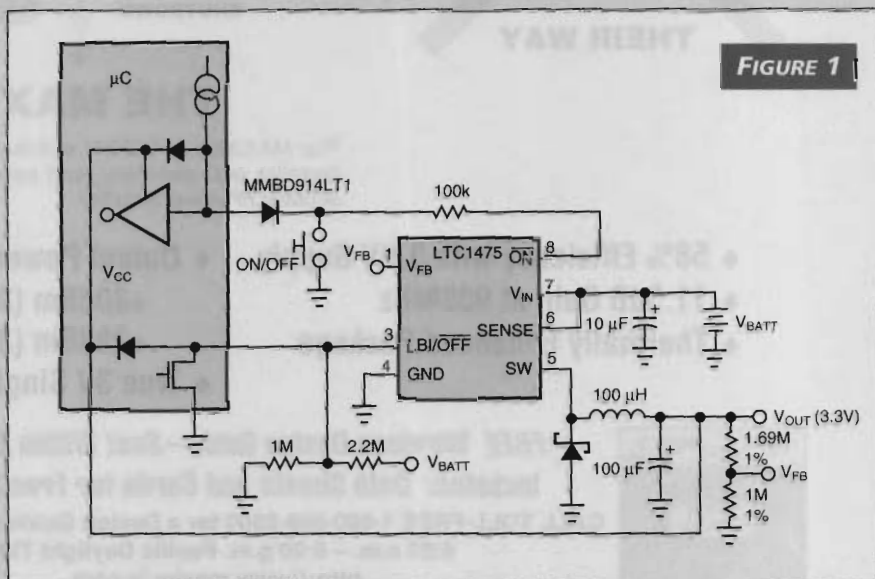


FIGURE 1

A simple circuit and pushbutton switch control the shutdown of both the switching regulator (IC₁) and the μC .

because most μC s have a parasitic diode between each input and the supply. The '914 is thus necessary to prevent the μC , when it powers down, from pulling down IC₁'s $\overline{\text{ON}}$ and subsequently turning back on the regulator. (DI #2094) **EDN**

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